

# Modern Concepts of Cardiovascular Disease

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## FUNCTIONAL TESTS OF THE HEART

In judging the functional integrity of the heart as a whole, two questions must be answered. These are: (a) Is the heart's ability to work as an efficient pump disturbed, and if so to what degree? (b) Is the heart suffering from or likely to suffer from an impairment of its own blood supply? The answers to these questions furnish information concerning the presence or imminence of the two important complications of chronic cardiac disease—congestive heart failure and angina pectoris.

A. *Estimation of the functional capacity of the heart as a pump.* When the heart is working in a grossly inefficient manner congestive manifestations appear. Since the majority of the conditions which cause cardiac disease affect the left side of the heart primarily, engorgement usually develops first in the pulmonary vascular bed. It is revealed by: (a) dyspnea on exertion or at rest which may occur in paroxysms, may be provoked by assuming the recumbent posture, or in severe cases may be continuous; (b) rales at the lung bases; (c) decrease in the vital capacity. In contrast to these signs of left sided heart failure are those of right sided failure, which are dependent on congestion in the systemic vascular bed. They are: (a) cervical venous distention, when this occurs with the patient in the sitting position; (b) an enlarged and tender liver; (c) cyanosis; (d) edema, and (e) accumulations of fluid in the body cavities.

When these signs of congestion are present they indicate that the heart is carrying on its work in a grossly inefficient manner and further functional tests are unnecessary.

More difficult (and more common) are the cases in which outspoken congestion is absent. In such instances one desires to know whether congestive failure is likely to occur, and if so whether in the immediate or in the remote future. Such information, which is of great importance to the patient, cannot be obtained from any simple procedure. Numerous tests have been devised in which conclusions are drawn from measurements of the blood pressure and the pulse rate before and after standardized exercise. They are unsatisfactory for the reason that the pulse rate and blood pressure are determined not so much by the activity of the heart as by that of the nervous system, and are readily affected by psychic, emotional, and reflex influences.

More reliable results can be obtained by measuring the volume of air breathed during standardized exercise but this requires special apparatus and the patient needs to be trained to the procedure. Electrocardiograms rarely yield important information concerning the capacity of the heart to perform work.

Investigations of the cardiac output are laborious and require expensive apparatus. Furthermore, although such tests, when coupled with measurements of the blood pressure, may allow an estimation of the work the heart is doing, they do not yield information concerning either the maximum work it can do or the efficiency of its performance.

The most generally useful simple objective test of cardiac function is the measurement of vital capacity. This may be carried out with any of the spirometers which are used to measure the basal metabolism. Following a maximal inspiration the subject makes a maximal expiration into the apparatus and the volume of the air breathed out is noted. Progressive decrease in the vital capacity is usually the earliest detectable sign of congestion of the lungs. Single determinations of this function are of limited value, because the vital capacity is not only dependent on the amount of blood in the lungs but on the patient's sex, size, age, nutritional state, occupation, thoracic development and general physical fitness. However, in a given patient, changes in the cardiac condition are usually well reflected by corresponding alterations in the vital capacity. For this reason and because of its simplicity the test should be employed as a routine in the management of persons with cardiac disease.

Ordinarily one cannot draw conclusions concerning the functional integrity of the heart from the results of physical examination of the heart itself. The character and intensity of the sounds and of murmurs are valueless in this respect. The presence of a gallop (ta-lubb-dup or lubb-dup-ta) is of importance, however. This sign is brought about by dilatation of the heart, and it generally indicates that congestive failure is either imminent or present. (The absence of gallop rhythm is of no import.) Marked cardiac enlargement although compatible with a well compensated circulation for a given time, generally indicates a grave ultimate outcome. Attempts to estimate the heart's capacity

on the basis of its rate or rhythm are likely to lead to erroneous conclusions.

Of all the tests of cardiac function the most reliable is the patient's response to effort. In this regard his story concerning the conditions which produce dyspnea is the chief guide. When a specific performance such as climbing a flight of stairs, which has previously been done without discomfort, begins to produce respiratory distress, the cardiac reserve is declining. If walking on level ground at an ordinary pace induces breathlessness, the heart's functional capacity is seriously impaired. The occurrence of dyspnea at rest indicates that the heart has become grossly inefficient and that pulmonary congestion has developed.

In the interpretation of breathlessness due regard must be paid to non-cardiac factors that frequently play a significant role in the symptomatology. Of particular importance is dyspnea from pulmonary or bronchial causes especially chronic bronchitis and emphysema. They are common occurrences in cardiac as well as non-cardiac patients and that portion of the shortness of breath that is due to the bronchial factor need not be very serious. The same may be said of obesity. When the excess of weight is considerable, this of itself can cause uncomfortable dyspnea and more so if there exists already an otherwise well compensated organic cardiovascular abnormality. Finally functional dyspnea often manifesting itself as "Sighing breathing" needs to be carefully distinguished, for this does not indicate structural disease of the heart.

To summarize: Helpful information concerning the heart's efficiency as a pump may be obtained by study of the vital capacity, to some extent by the size of the heart, and by the detection of a gallop rhythm. The most important guide to the heart's function, however, is the patient's history as to the amount of activity required to produce dyspnea, and more especially as to whether this symptom is called forth by progressively diminishing muscular effort.

**B. Estimation of the functional integrity of the coronary circulation.** The usual cause of deficiency of the blood supply to the heart muscle is coronary arteriosclerosis. This is a frequent occurrence in persons whose hearts are entirely normal to physical examination. Characteristic changes in the electrocardiograms are present in a considerable number of instances but are frequently lacking. The diagnosis of coronary arterial disease and the estimation of its severity are therefore mainly dependent on the patient's story. The characteristic clinical syndrome is that of angina pectoris. Although the degree of the pain does not necessarily parallel the extent of the disease process, the two are correlated. Pain brought on only by severe exertion usually indicates slight coronary disease; while its appearance on mild effort points toward a more extensive process. It is thought by most observers (but it is by no means certain) that the occurrence of angina pectoris at rest and particularly during sleep signifies advanced disease. The prognosis is very uncertain in all patients with angina pectoris

and the two common complications—sudden death due to ventricular fibrillation and coronary thrombosis—may occur at any stage of the disorder.

It must be borne in mind that there are other "accidents" of heart disease that are extremely difficult to predict, which suddenly alter the prognosis. These complications cannot be anticipated by any of the functional tests and not even by the patient's symptoms. Examples of such "accidents" are the development of subacute bacterial endocarditis, the occurrence of emboli and sudden changes of rhythm, such as auricular fibrillation or complete heart block with Adams-Stokes syncope.

There is therefore no short cut to the estimation of cardiac function. A decision cannot be reached by any one test but must be based on the correlated results of a careful and complete examination. The most valuable single guide as to the functional capacity of the heart muscle as a whole is the degree of effort which can be tolerated without dyspnea. Similarly, the most reliable index to the state of the coronary circulation is the amount of muscular work which can be performed without pain. Objective methods of examination yield less information than the patient's own sensations.

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#### SELECTED ABSTRACT

Levine, S. A., Cutler, E. C., and Eppinger, E. C.: Thyroidectomy in the Treatment of Advanced Congestive Heart Failure and Angina Pectoris. *N. E. Journal of Medicine*, 209; 667: (Oct. 5) 1933.

Levine and his co-workers reported the result of removing the thyroid gland as a method of treatment in twelve patients suffering from the most severe forms of heart disease. There were four with angina pectoris, four with valvular, and four with non-valvular congestive heart failure. They were all hopeless cardiac cripples, and for the most part bed-ridden and refractory to all known methods of treatment. Improvement in six was marked, and in three it was slight to moderate. A generous sub-total thyroidectomy was performed in the first three cases; all the subsequent operations consisted of complete removal of the thyroid gland.

This is one of a series of publications on similar or allied subjects with reference to the relation of the thyroid gland to heart disease. As a result of a fortuitous experience in 1927, Levine observed that the removal of a normal thyroid gland might be helpful in the treatment of intractable heart failure. This initiated the subsequent work which was carried out at the Peter Bent Brigham Hospital and the Beth Israel Hospital. Levine and his associates in Boston believe that this new procedure will prove helpful in some properly selected patients suffering from various forms of heart disease, who do not improve on the measures customarily used.

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